A FORM FOR CONTAINING SETTABLE FILLER MATERIAL DURING SETTING

This invention relates to a form for containing and shaping a settable filler material during setting of the material and particularly with forming a pumped high strength grout or concrete type material into a column shape and holding the material while it sets. The material with which the present invention is primarily but not exclusively concerned is that used for creating high strength reinforcement columns in a mine shaft to prevent collapse of the shaft.

BACKGROUND OF THE INVENTION

Fabric bags are used for containing many bulk materials. Some bags are used for transporting particulate materials. Such bags are commonly formed by stitching woven polypropylene fabric to forms walls of the container and in many cases a liner is provided.

Fabric containers are often used also for containing fill material to form a geo-textile container which holds the fill material in location.

One example of a geo-textile container is shown in US patent 5,902,070 of Bradley Industrial Textiles Inc. This comprises a tubular body which may typically be 2000 feet in length and may typically be up to 45 feet in diameter. Such a tubular body is used to contain fill and is located in a bay to reduce erosion.

The use of a strip of material which is wound helically to form a tube is previously known and is used in a number of different circumstances for forming a tubular cover. The above patent utilizes this known technique for manufacturing a geo-textile tube which includes the helically formed tube together with a liner. These techniques, it is stated, overcome the weakness of the seam.

In an entirely unrelated field, forms are used to manufacture concrete columns. In many cases the form is a tubular cardboard or paper structure which contains the concrete for a sufficient period of time for it to set. In cases where the column is of too large a diameter or where the structure is more complex, the form work necessary to support the concrete material while it sets is generally fabricated from wooden panels and suitable supporting framework.

It will of course be appreciated that a large diameter column of a significant height generates very high pressures at the lower part of the column thus tending to burst or expand containing materials. For this reason cardboard or paper products are completely unsuitable for containing columns having a diameter greater than of the order of 18 inches.

One field where trials have recently been carried out is that of providing reinforcing columns within a mine shaft to provide sufficient strength to support the roof of the mine shaft against collapse after the mine shaft is abandoned. Such columns must provide very high strength and of course must be cast in place to provide a complete support between the floor and roof of the shaft. For this purpose conventional concrete is generally unsuitable and it has been necessary to generate new high strength settable filler materials or grout which can provide, generally without steel or other reinforcements, the necessary strength to provide support for the mine shaft without the necessity of filling the whole shaft across its full area or volume.

Such filler materials which are suitable for this purpose generally are pumped in a hot fluid condition. Up until now the only suitable technique to contain the fluid materials in their heated condition until set has been to provide the conventional panelling and framework. However it will be appreciated that this construction is highly labour intensive and therefore very expensive.

Some trials have been carried out for the use of fabric bags to contain the hot fluid grout material until set. However these fabric bags have generally failed in trials due to the high forces at the bottom of the tubular bag which tend to bow or expand the bag at that area thus allowing the filler material to slump so that it fails to provide its proper shape and construction. Also the heat of the fluid material exacerbates the tendency of the fabric bags to expand. The failure of the bags has therefore not been at the seams but has instead been over the body of the fabric material itself which has simply expanded sufficiently to fail in its requirement to maintain the required cylindrical shape.

SUMMARY OF THE INVENTION

It is one object of the present invention, therefore, to provide an improved form construction for containing and shaping a settable filler material during setting of the material.

According to a first aspect of the invention, therefore, there is provided a form for receiving and containing a settable filler material while the material sets comprising:

a tubular wall;

two circular end panels;

the wall and end panels each being formed from a flexible woven polymer fabric;

each of the panels being stitched around its circular peripheral edge to an end edge of the tubular wall;

at least one filler opening into the form for receiving the filler material;

wherein the tubular wall is formed from a strip of the fabric which is arranged helically such that one side edge of the strip is stitched to an opposed side edge of a next turn of the strip to define a stitched seam which extends helically around the tubular wall from one end panel to the opposite end panel.

The fabric is flexible such that the form can generally be folded flat for transportation and storage and for location within confined areas.

Preferably the flexible woven fabric is laminated on its inside surface with a metal foil layer.

Preferably the strip of fabric has a width relative to the diameter of the tubular wall such that the strip extends in at least one turn of helix and such that preferably the strip lies at an angle of the order of 45 degrees relative to a line transverse to the longitudinal axis of the tubular member.

Preferably there is provided a filler opening in one end panel and a filler opening in the tubular wall, although in some cases only a single filler can be provided. Such a filler opening includes preferably a closing spout using a tie closure or the like of a conventional nature well known to one skilled in the art.

Preferably there are provided support straps adjacent the one end panel which has the filler opening.

Preferably the tubular wall and the end panels each consist of single layer of the fabric.

Preferably the tubular wall and the end panels are stitched together with stitched seams on an outside of the form where the seams are preferably simple overlapping seams.

Preferably the flexible fabric is polypropylene woven fabric, which is convenient, relatively inexpensive and readily available. However other materials may be used in special circumstances where additional expense may be warranted.

Preferably the flexible woven fabric is of a transportation bag grade and thus is substantially imperforate as opposed to geo-textile materials which tend in most cases to be perforated to allow water flow through the material while retaining fill material within the container formed by the material.

According to a second aspect of the invention there is provided a form for receiving and containing a settable filler material while the material sets comprising:

a tubular wall;

two circular end panels;

the wall and end panels each being formed from a flexible woven polymer fabric;

each of the panels being stitched around its circular peripheral edge to an end edge of the tubular wall;

at least one filler opening into the form for receiving the filler material;

wherein the flexible woven fabric is laminated on its inside surface with a metal foil layer.

According to a third aspect of the invention there is provided a method for forming a support column comprising:

providing a form for receiving and containing a settable filler material, the form comprising:

a tubular wall;

two circular end panels;

the wall and end panels each being formed from a flexible woven polymer fabric;

each of the panels being stitched around its circular peripheral edge to an end edge of the tubular wall;

at least one filler opening into the form for receiving the filler material;

locating the form with one end panel uppermost at a surface to be supported and with the opposite end panel resting on a floor surface;

pouring into the form a heated settable filler material;

and causing the filler material to set while contained by the form;

wherein the flexible woven fabric is laminated on its inside surface with a metal foil layer.

According to a fourth aspect of the invention there is provided a method for forming a support column comprising:

providing a form for receiving and containing a settable filler material, the form comprising:

a tubular wall;

two circular end panels;

the wall and end panels each being formed from a flexible woven polymer fabric;

each of the panels being stitched around its circular peripheral edge to an end edge of the tubular wall;

at least one filler opening into the form for receiving the filler material;

locating the form with one end panel uppermost at a surface to be supported and with the opposite end panel resting on a floor surface;

pouring into the form a heated settable filler material;

and causing the filler material to set while contained by the form;

wherein the tubular wall is formed from a strip of the fabric which is arranged helically such that one side edge of the strip is stitched to an opposed side edge of a next turn of the strip to define a stitched seam which extends helically of the tubular wall from one end panel to the opposite end panel.

BRIEF DESCRIPTION OF THE DRAWINGS

One possible embodiment of the invention will now be described in conjunction with the accompanying drawings, in which:

Figure 1 is an isometric view of a form according to the present invention when expanded from a folded condition ready to receive the settable material.

Figure 2 is a cross sectional view through the form of Figure 1 showing it in the installed condition with the settable material contained therein and setting to form a reinforcement column.

Figure 3 is a cross sectional view through one seam of the form of Figure 1 showing the construction of the seam and the fabric from which the form is manufactured

DETAILED DESCRIPTION

In Figure 1 is shown a form 10 which is defined by a top circular panel 11, a bottom circular panel 12 and a tubular wall 13. The tubular wall 13 is formed from a strip 14 of fabric which is wound helically to for a series of turns of the strip which are indicated at 14A, 14B and 14C along the length of the tubular wall 13. Thus one side edge 15 of the turn 14B is stitched to a second side edge 16 of the turn 14C. Thus the side edge 16 of the turn 14B is stitched to the side edge 15 of the turn 14A.

In practice the strip can have a long length from a suitable rolled supply and can be formed continuously into a continuous helical tube having the required diameter of the tubular wall 13. From the continuous tubular body, sections can be cut in transverse direction to the axis of the tubular body thus cutting the strip diagonally so that each of the turns 14A and 14C has a diagonal transverse cut

forming a bottom end 17 of the tubular wall and a top end 18 of the tubular wall. In practice the material can be folded flat for cutting since the fabric is flexible and can be laid flat after the stitched seams are formed.

The end panels 11 and 12 are simply flat circular panels formed from the same fabric which are then stitched so that the peripheral outer edge 19 of the panel 11 is stitched around the top edge 18 of the tubular wall and the peripheral edge 20 of the panel 12 is stitched around the bottom edge 17 of the tubular wall. The seams are formed on the outside of the structure for convenience of manufacture since the appearance of the product is of little or no importance and the product will not be in view once it has been used to provide the form for the material since the installation is in almost all cases at a location where neither the column nor the exterior form work will be visible.

The exterior seams are shown in one example in Figure 3 where the helical seam between the edges 15 and 16 of the turns 14A and 14B is shown. Thus the edges are simply turned outwards to form overlying flanges which are then stitched together by one or more rows of stitches along the seam as indicated at 25. In examples shown there are two rows of stitches shown at 25 and 26 side by side. Other forms of stitching can be used to provide seams of increased strength but generally this is not necessary since a simple overlapping seam can be used as the strength of the seam is not seriously tested in the construction herein.

The fabric from which the side wall and the panels are manufactured is also shown in Figure 3 and is a laminated fabric including an outer layer 30 and an inner layer 31.

The outer layer 30 is a woven polypropylene fabric having the following typical characteristics.

The layer 31 is a metal foil layer laminated onto the inside surface of the woven fabric layer. The woven fabric layer is free from coatings so that it consists solely of the woven yarns and the foil layer is laminated onto the inside surface of the fabric by a suitable adhesive material. The foil is preferably of a thickness so that it is highly flexible with the flexing of the fabric. Aluminium foil is suitable in view of its cost, handling and flexibility.

The forms typically have a diameter of the order of 2 to 5 feet and one example is of the order of 3 feet in diameter which has been certain to provide the necessary structural strength for the fabricated column. The height of the tubular wall is typically in the range 6 to 8 feet which is sufficient to provide a structural support between the ceiling and floor of the mine shaft. Larger forms can also be used both in diameter and in heights for larger mine shafts.

The width of the fabric strip 14 is selected relative to the diameter of the tubular wall so that the seams extend diagonally relative to a line transverse to the longitudinal axis of the tubular wall which angle is indicated at A which lies of the order of 45°. This angle can be varied within a range which can be selected by one skilled in the art bearing in mind that a smaller angle to the transverse line that is a

larger angle to the longitudinal axis will act to increase the number of turns around the axis which will assist in maintaining the form at the bottom of the bag where the forces are greatest and increase strength characteristics. However the limits on the angle arise due to an increased difficulty in manufacture so that the selection of angle is based upon a balance of increased strength relative to manufacturing difficulty..

The construction set forth above also lays the fabric on the bias relative to the axis of the tubular wall.

The use of the diagonal wall structure has been found to reduce the expansion of the fabric at the lower part which can cause slumping of the contained filler material. The use of the foil laminated liner on the inside surface of the fabric has also been found to reduce the expansion of the fabric when containing the heated filler material. The two features in combination are preferably used since in combination they provide the best arrangement for reducing the tendency of the fabric of the tubular wall from distorting from its normally cylindrical shape. It is believed that the bias arrangement of the fabric together with the heat dissipating characteristics of the liner tend to reduce the possibility for the fabric to soften and expand particularly at the areas of highest pressure.

In order to fill the form with the settable heated filler material, a first filler opening 40 is provided in the top panel 11 and the second filler opening 41 is provided in the side wall at a position approximately mid-height of the side wall. These filler openings are of the type having an neck 43 into which the filler material

can be injected by wrapping the neck around a filling pipe. The neck can be tied off by a suitable wrapping 44 which then closes the neck to prevent the filler material from gushing or escaping from the form, bearing in mind that the filler material is generally under pressure within the form and is sufficiently liquid to flow into the form and to fill all voids within the form.

In order to support the form within the zone to be filled, there is provided a pair of support straps 50 on the side wall adjacent the top end panel 11. The straps 50 are provided on the side wall just downwardly from the panel so that the panel can be located at the ceiling while the straps are held on suitable connectors attached to the ceiling on each side of the tubular wall. Additional straps can be provided for additional support.

The form of the above construction has been found to provide sufficient support for the heated filler material for a sufficient period of time to allow the filler material to set in the required position without slumping during the setting. While the fabric is impermeable in view of the laminated foil layer, there is sufficient openings at the stitch lines to allow excess water to escape if necessary.

When the material is set, the form can simply remain in place since in most cases its presence is irrelevant to the function thus avoiding the necessity for its removal.

Since various modifications can be made in my invention as herein above described, and many apparently widely different embodiments of same made within the spirit and scope of the claims without departing from such spirit and

scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.